Safeguard Hardware Against Inadvertent Overtesting

The Problem:

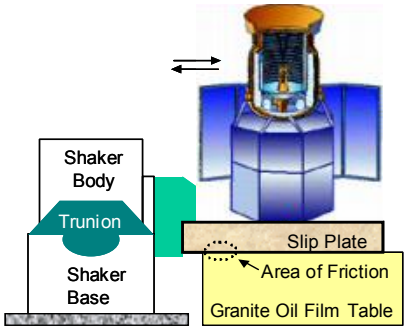
A satellite suffered considerable damage during vibration test because worn-out equipment misled the test operator into applying an excessive force.

The Cause:

Prior to vibrating the spacecraft, the operators first subjected it to a low-level calibration test to compute how much force should be applied to achieve the specified acceleration.

Unfortunately, the shaker was over 40 years old, and its trunion bearings had broken. The slip plate came into contact with the shaker table, resulting in an interference that attenuated the satellite's motion.

Unaware of the malfunction, the test engineer thought a much larger force needed to be applied to achieve the required acceleration. This force overcame the start-up friction, but overshot the acceleration by tenfold, damaging the spacecraft.



Friction during start-up can greatly exceed that during operation. This problem, known as stiction, frequently causes trouble. For example, when a tape drive is adjusted, the tape may not move until enough voltage to overcome the stiction is applied; but then the force is too large, and the tape suddenly runs wild.

Lessons Learned:

- Make sure that test facilities are maintained and checked.
- Implement overtest protection (such as over-temperature trip circuits in thermal chambers).
- Take risks of overtesting during vibration tests into account. In particular, large satellites should typically be acoustically tested instead of vibration-tested to prevent damage.
- Step up vibration tests from one-third to one-half of the full level so that the required force can be more accurately computed.
- Test procedures, set up, and data should be thoroughly checked to account for operator mistakes and avoid damage.

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